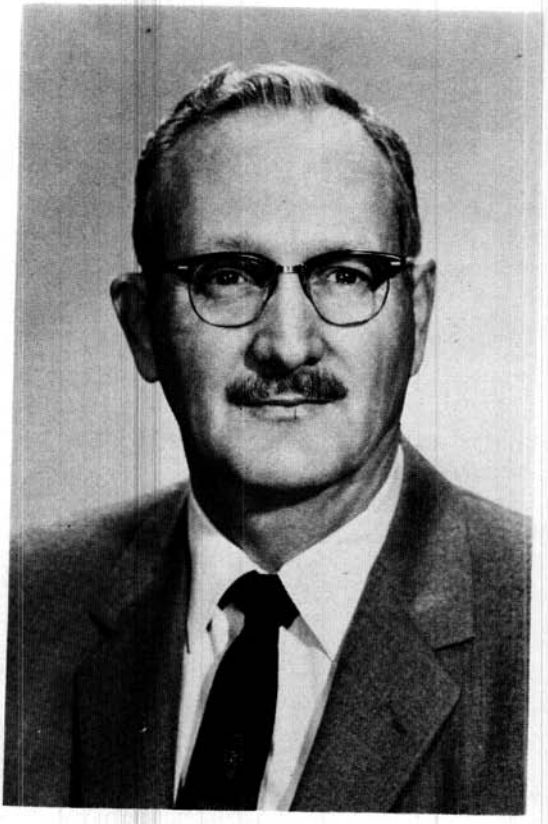
PRESIDENTIAL ADDRESS

THE IMPORTANCE OF BEING NOURISHED

HARLOW B. MILLS
State Natural History Survey, Urbana



HARLOW B. MILLS, *President*, 1958-59

Those of us who have been fortunate enough to raise children will recall that day to day progress in their development is almost impossible to discern. Even at monthly intervals we may have difficulty in noting change. But if we see someone else's youngster after a period of a year, the changes will be obvious. Changes in an old college classmate whom we may meet after 30 years may shock us. So it is with many things about us. Small increments of change which we see regularly may pass almost unnoticed, but large changes may startle us.

Today I should like to discuss some things that are sneaking upon us insidiously, and which we take for granted whether they are for good or bad. The first has to do with numbers of people and their needs and wants; the second has to do with the fulfillment of these necessities; and finally I should like to talk about our responsibilities in these matters.

But before we get into these considerations, let us generalize for the moment.

A long while ago an English preacher by the name of T. R. Malthus stated that human populations tend to be controlled by the food supply. There are those who believe that the old theorist was wrong, but in our western civilization we have not as yet tried out his idea.

We are constantly thrilled and chilled by the great advances made in the physical sciences in the past few decades. The theoretical energy contained in the atom has been brought out of the ivory halls, and the ivory crania of a few philosophers. This theory turned out to be intensely practical, and it was unveiled to the world most dramatically. It was analogous to jumping into an icy lake.

But quietly, without fanfare, and forming scarely a ripple in the stream of consciousness of the most of us, another scientific miracle has occurred. We have temporarily kicked Malthus down into the cellar. We have developed food-producing methods which are the real phenomena of the age, for we can live without our own brand of atom fission but we cannot live without food. We have done a stupendous, a gigantic thing which is without precedent. We have, in my lifetime, doubled our populations and at the same time greatly increased our standard of living. And this, I repeat, has caused scarcely a murmur among the populace; we have taken to it as naturally as we take breaths of air.

Possibly because this achievement sneaked in the back door unnoticed, we find that there are those who feel that it was a natural thing, that it can go on indefinitely, and that there will be no problems in the future; that we can support an almost unlimited number of people on the earth. And this has given rise to two groups with opposite points of view, the "Dangerous Optimists" and the "Fearful Pessimists": those who sing "Hallelujah," and those who cry "Doom."

It is interesting to note that a generalization can be made concerning these two groups. The optimists seem generally to be the production scientists, the applied scientists, and the trusting laymen. The pessimists seem generally to be the more basic scientists, often basic biologists.

In this connection we must not pass without a comment on the place of science in human affairs. The general public, seeing only end results of scientific activity, tends to feel that science has no limits, that there are no problems which it cannot solve. We must remember that too much faith can be put in our powers. We must remember that there is somewhere a limit to our abilities and our production. We must have the humility to remember that we cannot solve all human ills.

People. First let us talk about

people. As a race we have been on the earth for from a half-million to two million years. For hundreds of thousands of these years people skulked around in odd places, grabbing when the opportunity afforded itself and being grabbed when at a disadvantage. The important thing is that humans did survive, and that they held their own and moved about here and there, not diminishing in numbers although not increasing rapidly.

Through all of the history of the human race but the immediate past, growth in numbers must have been slow. In an issue of *Science* of about two years ago, Woodbury says, "The world population is estimated to have doubled from 100 million to 200 million in the first 1000 years A.D., more than doubled from 500 million to 1200 million in the 200 years from 1650 to 1850, and again doubled from 1200 million to 2400 million in the century from 1850 to 1950." If we come to relatively modern times we have some fair census figures:

WORLD POPULATIONS

Year	*Millions*		*Annual increase*
1650	470		
1800	870	5.1X in	2.7
1900	1,600	300 years	7.3
1950	2,400		16.0
2000	3,600		24.0

Ralph W. Phillips, in a recent issue of *The Scientific Monthly*, dramatizes this increase by visualizing a dining table at which two linear feet are given to each person. To seat all people at once would require a table extending around the earth 20 times, with a small auxiliary table only 4,232 miles long. In addition it would be necessary to employ a crew of workmen who would be making tables at the rate of 17.8 miles a day. By 1960, says Mr. Phillips, we would need 21 tables extending around the earth, plus a long auxiliary one 18,500 miles in length.

Now let's see how Paul Sears looks at this question. In his article titled, "The Inexorable Problem of Space," in a recent issue of *Science*, he says that at the present rate of increase in about 22 generations, if we allow a spot 2 by 3 feet per person, there will be standing room only. This would, in 22 generations, put 4,646,400 people on a section of land, about as many people as were living in Massachusetts in 1950. Sears admits that he has allowed plenty of space per person, but believes that each should have enough so that he could reach into his pocket for the rent money.

To digress a moment, A. B. Guthrie recently has quoted Thomas Jefferson as stating that the limit of endurance of people was at a density of 10 per square mile. Beyond this density, Jefferson says people become uneasy, too much compressed, and emigrate in large numbers to new and unoccupied country. As early as 1787 in his *Notes on Virginia*, he expresses concern over population pressures. He assumes a population of 4,500,000 as a competent population for the state. It must be remembered that at that time Virginia extended west as far as the Mississippi River, and contained 121,525 square miles instead of the 40,815 now within its borders. This average of a possible 37 people per section must have concerned him, for he writes, "Yet

I am persuaded it is a greater number than the country spoken of, considering how much inarable land it contains, can cloath and feed, without a matieral change in the quality of their diet." Had anyone been able to tell him in 1787 that the population density of that part of Virginia with which he was intimately familar would by 1950 be 81 people per section, surely he would have been much more concerned.

Let us return now from our trip to Virginia. The soil scientist, Firman Bear, says that under pristine conditions there were about 2,400 acres for each American Indian. At the time of Benjamin Franklin's birth there were still about 1,900 acres for each person in the United States. By 1800 this had reduced to a per capita allotment of 400 acres, and by 1900 to 25 acres. In 1955 there were 12 acres per person, and, if there are 300 million people in the year 2000, this will be cut to 6. Now, if you consider that only about one acre in five is tillable, this leaves as of today less than three arable acres for each of us.

Let us see what has happened in the United States since 1800:

UNITED STATES POPULATION

Year	*Millions*		*Annual increase*
1800	5.3		
1850	23.2	28.5X in 150 years	0.36
1900	76.0		1.06
1950	150.7		1.5
1957	173.0		2.8

When we consider these figures we see all of the symptoms of a species of animal which is in irruption, which has got out of control, and which shows no signs of slowing down. In natural populations we consider this to be a danger sign, a forerunner of a depression in numbers, a break from a peak. If these figures are plotted we get a curve which is not a normal growth curve, but one which shows a startling upsurgence in numbers. Certainly it cannot be considered to be evidence of a normal, healthy, ongoing population.

Food. Earlier we made some strong statements about our growing food production. This growth is entirely due to scientific advancement. The numbers of Americans employed in agriculture have constantly decreased as food production has skyrocketed. In 1850 a farmer fed 5 people, in 1925 he fed 9, in 1950 he fed 15, and in 1955 he fed 20. At the same time the acreage under control of each farmer has increased. Greater efficiency, modern methods, have brought this about. We are no longer an agrarian culture. Farming nowadays might be said to be the field manufacturing of foodstuffs.

How did this come about?

Many scientific advancements contributed to the phenomenon. Hybrid crops produce much more on an acre than did the old open pollinated varieties. One hundred bushels of corn to the acre is now commonplace in the corn belt. New crops and new varieties of old crops have been put to use. More commercial fertilizer is now being used than ever before. Pest control has become a major science. Weed killers eliminate costly farming operations and cut down competition. New fungicides increase yields. Plant breeders have produced many varieties which are resistant to diseases and insects: sugar beets which do not get curly

top; wheat resistant to Hessian flies and wheat stem sawflies; wheat varieties which can withstand the deadly stem rust; apples resistant to scab disease; all of these things are in use or are being perfected. New insecticides so numerous and effective that they startle us are in use today. And well they might. Without them there would be little commercial potato harvest. Our own studies of abandoned peach and apple orchards show that without the use of insecticides and fungicides we would harvest only about 0.2% of the crop. By modern standards untreated fruit crops will yield only one marketable fruit in 500. Dr. G. C. Decker, on the basis of data from the United States Department of Agriculture, estimates that since the advent of DDT and its congeners, the yield of potatoes has risen 160%, onions 140%, sweet corn 160%, tobacco 125%, beet seed 180%, and alfalfa seed 160% (in the state of Washington alfalfa seed increased 420%).

Marketing has made tremendous advances. Take refrigeration and its contribution to keeping foods available throughout the season even though they may be produced seasonally. Grading has forced the production of quality products. Distribution systems have been developed to a high degree. Stored products can be protected from pests which cause deterioration.

All of these things have added to our use of food products made available through modern agriculture.

Furthermore, we are not generally using all of the tools which science has made available to us. The fertilizer industry calculates that if we used proven methods of fertilizing crops, methods tried but not in use, we could keep the present production of corn, cotton, wheat, and hay, and retire 42 millions of acres. Osborn has said that the application of new techniques has, in the 13 years prior to 1953, resulted in a gain the equivalent of production from 64,000,000 acres of land. In Illinois the corn yields for the past ten years have averaged 60% greater than before modern technology took hold.

Nor have we reached the end of this agricultural advance. Many advances are yet to be put into general use and many more are yet to be discovered.

This combination of scientific advance has put us in the anomalous and illogical position of producing foods in such quantities that we can neither eat nor sell them.

The Dilemma. What, then, are we faced with in the future? We are in the midst of a tremendous race, a race between people and their food supply. Populations are growing apace. The rate of increase in the United States is greater than the rate in India. Food production, where modern science has had time and the opportunity to work on it, has grown almost beyond belief.

But man must never overtake his ability to feed himself. And here scientists, and especially biologists, and among them especially biologists interested in population dynamics, have feelings of uneasiness. To carry the belief of the optimists to an ultimate and absurd conclusion, there is no limit to what people can do in feeding themselves! There is a limit, at least when we consider

conventional methods of producing food. And that is where the biologist gets concerned. Theoretically the ability of any successful organism to reproduce itself is infinite. The ability to produce food does have limits, though. It is the finite factor. On purely theoretical bases people *will* overcome their ability to think themselves into a square meal.

The June, 1958, number of the *Kiwanis Magazine* carries a thought-provoking article by Rear Admiral H. G. Rickover. Among many sobering comments we find the following:

"Ominous, too, is the fact that while world food production increased nine percent in the six years from 1945-51, world population increased by 12 percent. Not only is world population increasing faster than world food production, but increases in food production tend to occur in the already well-fed, high-energy countries rather than in the undernourished low-energy countries where food is most lacking."

Let us look at some of the finite factors in food production.

The production of food is dependent on the surface of the earth. Directly or indirectly, we get our nourishment from that surface upon which the sun shines. But we must be more specific. There are approximately 196,836,000 square miles of surface, according to Phillips. Of this, only 55,786,000 square miles are land, the remaining are water; only 28.3% of the earth's surface is land. Twenty percent of this area is in permafrost. More than 20% is too rough or too high for permanent human habitation. Another 20% is too arid for cultivation. That leaves us with less than 40% of the land surface to play around with in producing food.

Of the land available, we are losing area from production. Despite the greatest and most widespread interest in soil conservation ever known, we are still losing topsoil through careless handling. Further, we submit to what I call land usurpation. This is a rather new thing as an effective agent in reducing the food production potential, for until the last half-century we have been adding more acres than we have been subtracting. According to Ordway, farm, forest, and grazing land in the United States was reduced by 16,000,000 acres from 1935 to 1945. This went into the building of cities, industrial development, roads, highways, and the like. Kennard points to the Miami Valley in Ohio. Twenty-five years ago it was a rich, productive farming area. Now, particularly from Springfield to Cincinnati, this is an industrial area. There are those that believe that a strip from Milwaukee to Peoria will, before long, be completely usurped for residence and industry. When this happens St. Louis will grow north up the Illinois and the two urban areas will be joined.

From 1942 to 1956, on a nationwide basis, 20,000,000 acres have been withdrawn from food production. This is 5% of the total cultivatable acres in the United States.

The Department of Agriculture estimates that each year we are losing 1,250,000 acres of good farmland. From 1942 to 1957 Ohio, Indiana, Georgia, Florida, and Texas each lost about a million acres. Connecticut has lost one-third of its cul-

tivatable land, and it is estimated that another ten years at the present rate of usurpation will see the last of that state's good, commercial, producing farmland.

The optimists say that we can irrigate new lands. Testimony given by the United States Department of Agriculture before Congress in 1952, according to Osborn, indicates that the food and export needs of the country by 1975 will require 113,000,000 more acres than are now being farmed, and this is 70,000,000 more acres than are planned on by the government in all of its land development and reclamation projects.

The tropics have always held an attraction to the optimists. All we have to do is to clear the Amazon basin and start to produce food and transplant people there. So far this has not worked. In a stimulating new book on the tropics by three Frenchmen, de la Rüe, Bourlière, and Harroy, there are some sobering comments: "The legend of the inexhaustible fertility of the soil in the hot countries has taken a long time to kill," they say. "Too many fantastic accounts have given rise to a strongly held opinion that the surfaces cleared of the great tropical forests are of an unheard-of richness.

It has now been convincingly shown that, generally speaking, the soils of the tropics have nothing like the fertility of those of temperate regions, that their yield under cultivation is in general less, and that they are also very easily destroyed."

And so it goes through the most of the proposals of the optimists.

Let us quote some pertinent comment from a couple of the thinkers of the day.

In a speech given by Dr. Milton Eisenhower, we find the following: "If we had at this moment a feasible 25-year plan to bring the diet of people everywhere up to about 2600 calories per person per day (a meager diet by your standard and mine)—if we had such a plan, I say, it would involve increasing world food production by 110 percent, taking into account the estimated increase in population. And I say in all earnestness that it is an open question whether food production, for all our science, can be increased by that much."

The University of Chicago's physiologist, A. J. Carlson, discusses the effect of modern medicine on the human race, and states that we are increasing the race faster than we are increasing food production. He concludes as follows: "What is the answer to this serious situation? Shall it be less of modern biology and medicine? more starvation? more violence and war? or more intelligence? . . . there is fairly good evidence that we must practically double the present world food production even to feed adequately the present world population. So far as can be judged, this cannot be done."

Well, that is that.

The dilemma in which we find ourselves now is apparent. What can we do with people, and what can we do with food? We are not only watching, we are participating in the greatest race in history—the race between the farmer and the obstetrician!

The Future. Now, what can we as producers of food look forward

to in this struggle?

In the first place, we will have to keep in mind that there is an inverse relationship between the numbers of people and individual freedom. If there were but one person on the earth there would need to be no laws governing the conduct and activity of society. If there were two people then there would have to be certain understandings between them. And so it goes. If we look back we can all list restrictions which have been imposed on us for the good of the whole populace. Grading restrictions affect the quality of those things which we produce. More recently we will recall the Miller Bill, which sets up federal machinery governing the allowable tolerances for pesticides in foodstuffs. To some this has meant a restriction in personal liberty, but it does only to the extent of need in protecting people who use the foods we produce.

Withholding taxes, increases in income taxes, are invasions of our right to earn according to our abilities and penalize the successful, but they seem to be needed in the protection of our citizenry.

I sometimes wonder if the large number of organizations which, although they may be very moral, prey upon the family units are not regimenting both parents and children right out of the family where they belong.

Our work is organized and regimented. Our recreation is regimented. In this country, where there is great freedom of thought and criticism it is probable that our thinking is either purposefully or unconsciously molded into patterns.

As people become more abundant our personal radii of freedom become shorter and shorter. We haven't seen the end of this yet, and curtailments of personal liberties for the good of the whole population, which would now cause us great concern, will in the future be accepted as commonplace.

Some of this will come sooner than we anticipate, too. It is the function of increased numbers of people on the same area. Demographers know that the great increase in births which occurred in the forties will result in a great increase in marriages in the sixties, and a consequent increase in births again. This spells good times for the manufacturers of wedding supplies and baby rattles, but it also means a greater demand for food from the same or a smaller acreage of land. To the food manufacturer or producer this means greater sales of his products, but he would do well to consider this not as an economic boon but rather as a serious responsibility.

Eating is more than nutrition. It is not the mechanical ingestion of 2000 or 2600 calories a day. Man is differentiated from the other animals by his mental abilities, which are expressed in many ways. One is in his appreciation of his environment which may be expressed in the preservation of wilderness, an awareness of the birds of his area, the thrill of a bright sunset, or in a love of good food. He differs from an earthworm in this respect. And we have not as yet heard a corn borer ask for some monosodium glutamate, or a squash bug for nutmeg, or a cow for raisins in her breakfastfood, or a lion for Worchestershire sauce. I

am not implying that every person must become or now is a gourmet. What I am saying is that our standard of living demands more of our food right now than the ability to sustain life, and this makes more demands on food production and food processing.

Another point is worth mentioning. If in some way the population of the United States were to be stabilized at its present level the demand for foodstuffs would also tend to level off, but it would still rise at a considerably lower rate. To level it off completely would mean putting a ceiling on our standard of living as it is now, and it would be difficult to believe that this would occur while we have the ability to increase this standard. Not only is the per-capita use of food increasing, but the channeling of agricultural products into non-food uses is increasing; both of these uses are brought on by our increased living standards. Quality in our foods would not level off with a leveling population; quality demands will continue and will increase with time.

In discussing the future, let us go one step more. If man is to remain man he cannot live by bread alone. While the discussion of food and people may have seemed academic to some of you, it certainly is not in one respect. If we are willing to make the risky assumption that food and appetites will balance for some time to come, *the matter of space in relation to recreation will not*. If more space is needed for living it will be taken for living. If more space is needed for industry and other artifacts of our culture the pressure will be on us for that type of land use. If more land is needed for food production it will be put to that use.

These are sobering contemplations. As populations grow and land surface is more and more usurped, and, possibly long before human hunger strikes us, recreational needs will have to be protected much more assiduously than even now.

When we think of the future of recreational lands in all of this competition for land use, we cannot get away from zoning. We must think of areas where people will live, where they will work, where their roads will go, where they will produce their food, where they can find outdoor relaxation, and where wildlife can live and prosper. We may not like the idea of such regimentation; it will be an expression of restriction of personal freedom due to increased population density.

Perhaps we who are interested in the broad aspects of recreation are a little ahead in this area, for the setting aside of state and national parks, wilderness areas, and the like, certainly are a form of zoning. But for the future, what faces this exploding population? To provide for them we should now be in the business of acquiring land for recreational purposes; now while surpluses are plaguing us; now while there is still an abundance of questionable and submarginal land available; now before other human "needs" have usurped everything with a handle on it. Now is the time to add greatly to our recreational and protective land holdings for the millions who are yet to be born.

We have hardly tapped the store of things which an increasing popu-

lation will demand of us. In fact, we haven't the imagination to pick clean the bones of the future. It is much easier to pick the bones of the past. A newspaper reporter once visited a scientific meeting and covered a report on a new and peculiar fossil with an enlarged ganglionic space at the base of the spine. Rather than the usual press story, he was inspired to the following dozen lines:

"'Tis plain to see from these remains,
This creature had two sets of brains;
One in his head, the usual place,
The other at the spinal base.
Thus he could reason *a priori*,
As well as *a posteriori*.
No problem bothered him a bit,
He made both head and tail of it.
If aught escaped the forward mind
'Twas captured by the one behind.
And when in error he was caught
He had a saving afterthought.

In my attempts to translate an afterthought into a forethought, one thing should be clear to us all. There is an immense problem ahead for all of us who are interested in the well being of our descendants. And this problem carries with it an immense and immediate responsibility.

Literature Cited

Carlson, A. J. 1953. Does the greater understanding of man and nature increase the scientist's social responsibility? Science, 117:702.

Decker, George C. 1958. Don't let the insects rule. Agric. and Food Chem., 6(2):102.

Eisenhower, Milton S. 1948. Man, soil, and civilization. I. Northwest. Miller, 235(1):24, 74-75. July 6. II. Northwest Miller, 235(2):26, 30-31. July 13.

Guthrie, A. B., Jr. 1959. The West is our great adventure of the spirit. Life, 46(15):93.

Jefferson, Thomas. 1787. Notes on the State of Virginia. J. Stockdale, London, p. 119.

Kennard, T. C. 1957. The significance of cropland losses to industrial, urban, and highway development. Ohio Acad. Sci. Meeting, Bowling Green, Ohio, April 19, 1957. Processed Material, pp. 2, 7.

Ordway, Samuel H., Jr. 1953. Resources and the American dream. Ronald Press Co., New York, p. 17.

Osborn, Fairfield. 1953. The limits of the earth. Little, Brown and Co., Boston, pp. 61, 62.

Phillips, Ralph W. 1957. How adequate is the world's food supply? Sci. Monthly, 85(5):256, 260.

Rickover, Rear Admiral H. G. 1958. While we fiddle our fuels burn. Kiwanis Mag., June.

De La Rüe, Edgar Aubert, Francois Bourlière, and Jean Paul Harroy. 1957. The tropics. Alfred A. Knopf, New York, p. 26.

Sears, Paul B. 1958. The inexorable problem of space. Sci., 127(3288):11.

Woodbury, Angus M. 1955. Science, population, and arid lands. Science, 122 (3161):200.

Manuscript received April 30, 1959.